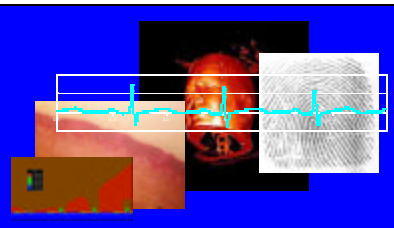

CITeR

The Center for Identification Technology Research

Lawrence A. Hornak
Center for Identification Technology Research
West Virginia University

The Biometric Consortium Conference
Arlington, VA February 13-15, 2001

CITeR
Center for Identification Technology Research
An NSF Industry/University Cooperative Research Center (IUCRC) in the area of Biometrics

West Virginia University
Michigan State University
Marshall University
San Jose State University
http://www.csee.wvu.edu/citer

Outline

- Motivation for CITeR as a National Science Foundation Industry/University Cooperative Center (I/UCRC)
- Formation, Organization, and Membership
- Initial Research Portfolio

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CITeR Motivation

- Establish a *comprehensive* academic research center able to effectively address research issues across the spectrum of academic disciplines necessary for the advancement of biometric systems.

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Automated Biometric Identification: A comprehensive view

CITeR Motivation

- Center Attributes
  - Achieve a virtual center drawing upon faculty expertise transparently across university boundaries
  - Effectively couple with academic programs to train graduate and undergraduate students
  - Promote and achieve knowledge transfer

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CITeR Motivation

- Central organizing principle:
  - Tightly couple the Center's research to Industry and Government needs at the outset.
    - User Community
    - Technology and System Developers
  - Maintain and grow a cooperative research and education environment

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CITeR as an I/UCRC

- National Science Foundation Center Models
  - Industry/University Cooperative Research Centers.
    - Key: *Membership Research $ Leveraging*
  - Research center in which academia and industry/government members cooperatively share the responsibility and the benefits (e.g. research, students, and IP).
- CITeR is the first I/UCRC for biometrics

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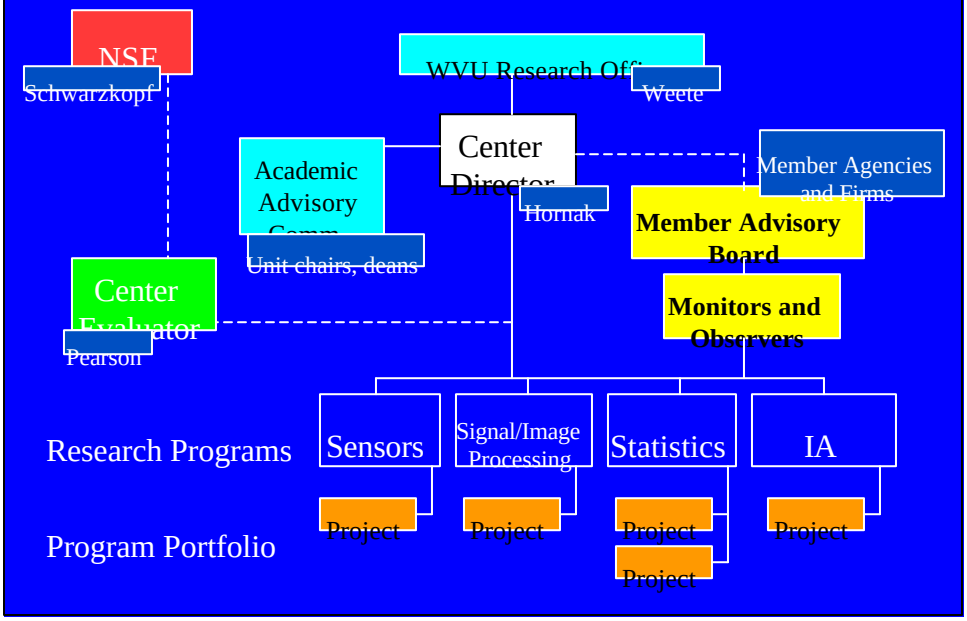
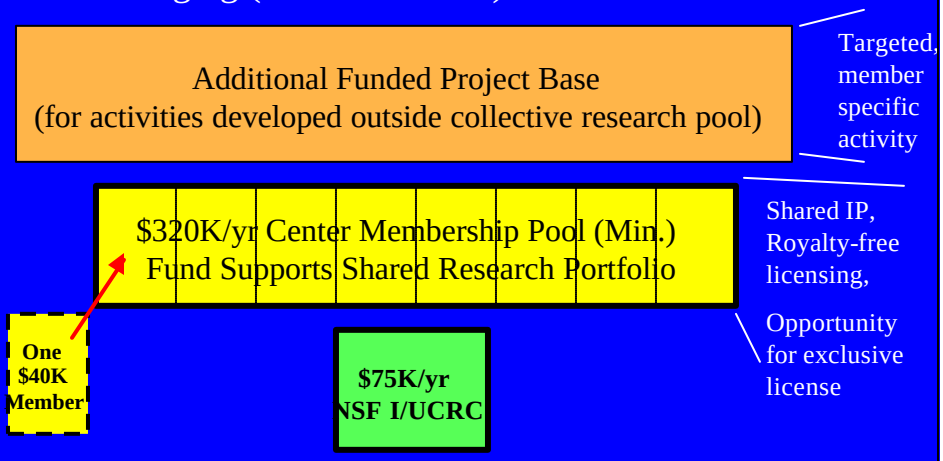
CITeR as a Multi-University I/UCRC



CITeR I/UCRC Basic Funding Structure

- I/UCRCs provide tremendous research dollar leveraging (10 to 1 or more) to its members.



Steps to NSF I/UCRC Designation

1. Concept Paper Approval Fall 00.
2. Planning Meeting, April ’01.
   - Purpose: To get Prospective Member input on how to best form CITeR to serve their needs.
   - Engage prospective members and center faculty in crafting the Center’s initial research portfolio.

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CITeR's Research Portfolio

Initial Research Project set and budgeting approved at planning conference:

- Study of Liveness Detection for Biometric Devices, *S. Schuckers, et al.* ($70K/yr)
- Multimodal Biometric System, *Jain* ($65K/yr)
- Estimation Study ($60K/yr) *M. Schuckers & Wayman.*
- Template Aging Study ($55K/yr), *M. Schuckers & Wayman*.
- Issues in Large Scale Biometric Authentication Infrastructure ($50K/yr), *Cukic*

Steps to NSF I/UCRC Designation

3. Operating Center Proposal, June '01
4. Center Award, December '01

- 9 Founding & 1st year Membership Commitments to date:

DoD Biometrics Management Office/BFC
Federal Bureau of Investigation
Viisage Technology
IMC, Inc.
Verizon
ManTech
NSA (2 orgs)
The Biometric Foundation

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Center Membership

- CITeR Membership Agreement
  - Mirrors standard NSF I/UCRC document
  - $40K yearly membership fee
  - Advisory Board Membership
    - Single vote on board per member
    - Research portfolio direction and oversight
    - Center Strategic Planning
  - Publication Review Policy
  - IP Policy, licensing

CEMR
LDCSEE

Study of Liveness Detection for Biometric Devices

Stephanie Schuckers, and Larry Hornak

Lane Dept. of Computer Sci. and Electrical Eng.

Timothy Norman,

Musculoskeletal Research Center, Health Sciences Center

West Virginia Unviersity

CEMR
LDCSEE

Background

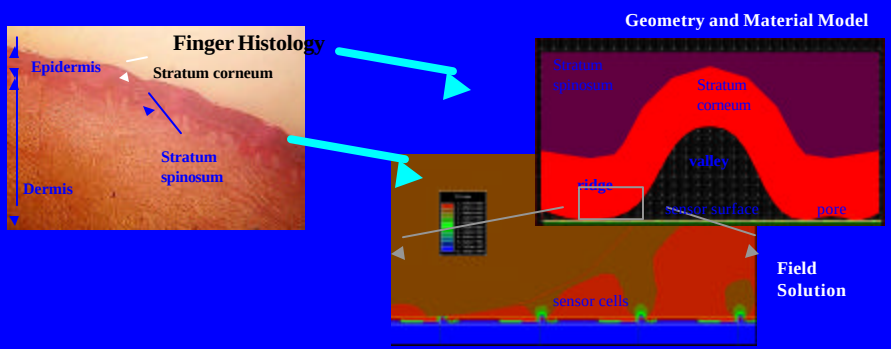
- Biometric devices can be spoofed by well-duplicated synthetic device or even a cadaver.
- Proposed anti-spoofing measures:
  - skin resistance
  - temperature
  - pulse oximetry
  - electrocardiogram
- Methods bulky and expensive
- ***Goal: Develop methods to determine liveness or vitality from data obtainable from existing biometric hardware given understanding of the physiology – device interaction***

S. Schuckers, L. A. Hornak and T. Norman

CEMR
LDCSEE

Previous Work - Overview

- Modeling and experiment showed high dielectric constant fluid (Perspiration) has high contrast
- ***New method captures time-varying perspiration pattern on fingertip***



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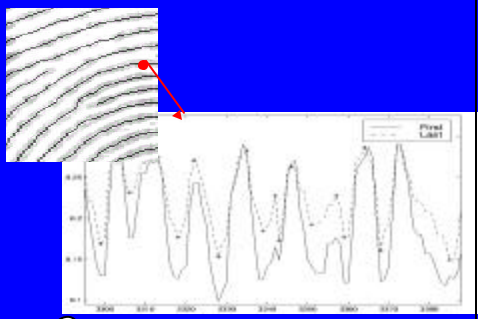
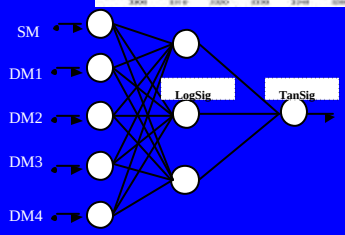
Previous Work - Algorithm

- Capture time-sequence of fingerprint images over 5 seconds
- Perform image processing to clean and convert images to a fingerprint "signal"
- Calculate static and dynamic features
- Use neural network to classify
- Tested on 18 each live, cadaver and spoof





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Previous Work - Summary

- 100% classification achieved on both training and test sets
- ***Able to develop a non-invasive, software method to determine liveness in fingerprint capacitance biometric devices.***

S. Schuckers, L. A. Hornak and T. Norman

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Proposed Work

- Select and secure biometric systems for liveness testing with IAB input
- Collect live, spoof, and cadaver data on selected biometric devices
- Develop liveness/spoof test by exploring available physiological information from biometric device on the training set
- Evaluate approaches on separate test set

S. Schuckers, L. A. Hornak and T. Norman

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Proposed Work

- Further study of perspiration algorithm on fingerprint devices
  - Increase number of subjects to include 30 of live, cadaver, and spoof
  - Expand fingerprint devices tested to different sensor technologies (optical, other solid state)
  - Explore reducing capture time (currently 5 seconds)
  - Optimize pattern recognition algorithm

S. Schuckers, L. A. Hornak and T. Norman

Multimodal Biometrics

Anil Jain
Department of Computer Science
Michigan State University

http://biometrics.cse.msu.edu

Mutimodal Biometrics

- Multiple sensors that capture different biometric traits
- Multiple pieces of evidence
- Fusion schemes required to *integrate* information provided by the individual modalities

Anil Jain
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Fusion in Biometrics

- Fusion at the feature extraction level
  - *Combining extracted features*
- Fusion at the confidence level
  - *Combining matching scores*
- Fusion at the abstract level
  - *Combining accept/reject decisions*

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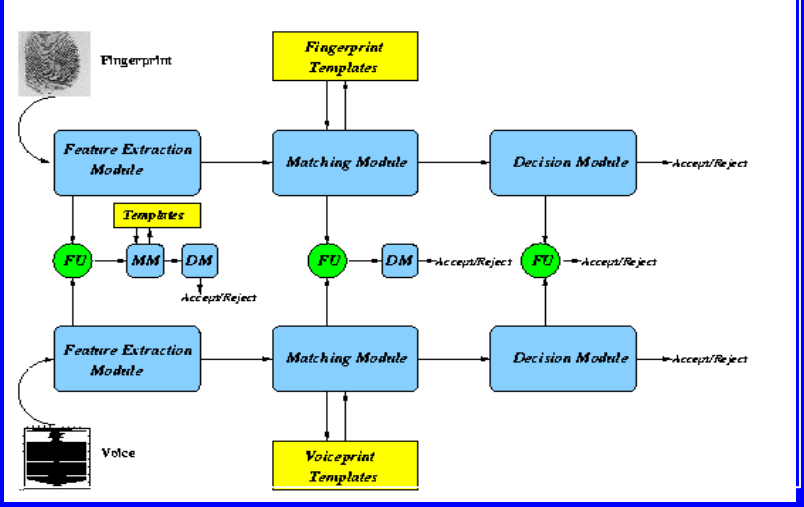
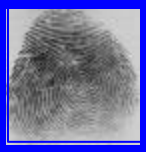
An Example



Three Modalities



- Face Location
- Eigen Vectors
- Euclidean distance

Distance Score

- Minutia Points
- String Matching

Similarity Score

- Lengths/Widths
- Euclidean distance

Distance Score

Scores are normalized within each modality.

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Combining Scores

- Sum Rule:
  Weighted sum of scores from multiple modalities
- Product Rule:
  Weighted product of scores from multiple modalities
- Min/Max/Median Rule:
  Choose the min/max/median score of the multiple modalities

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http://biometrics.cse.msu.edu

Proposed Work

- Fusion at the representation level: *Combine filterbank features (fingerprint) with eigen vectors (face) and shape features (hand)*
- Different rules for fusing scores
- User–specific biometric indicators: *Each user may have different weights associated with the individual modalities. These weights can be learnt over time*
- Build a prototype log-in system that uses multiple biometric indicators - face, fingerprint, hand geometry and voice
- Evaluate system performance for a large number of users

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Statistical Analysis Projects

Michael Schuckers, WVU and James L. Wayman, SJSU

Error Estimation Study

Addresses issue that there is no present method for estimating *variability* in the estimate of a single value of FAR, FRR. Consequently, no method for determining sample size needed for testing. Explore beta-binomial distribution [Auto-ID `02]

Template Aging Study

Initial project seeks to lay the groundwork for subsequent study to understand the time dependent variability of specific classes and types of biometric templates.

Issues in Large Scale Biometric Authentication Infrastructure

Bojan Cukic WVU

– Biometric authentication protocols: survey, problems, perspectives, propose research directions
– Applicability of existing encryption protocols and hashing functions to digital biometric signatures
– Software and system assurance methodologies and unique challenges of biometric authentication systems

CITeR Semi-Annual Meetings

- Fall and Spring Center meetings
  - Open Sessions:
    - Open to invitees of membership and faculty
    - Address special topics
    - Showcase activities of Center and Membership
    - New member recruitment
  - Closed Sessions:
    - Members, Students, and Faculty
    - Current project progress & final reports
    - New project development and selection
    - Advisory Board Meeting & Planning Sessions
- Next Meeting mid-April 2002

Spring 2002
CITeR NSF I/UCRC Conference
April 15-16, 2002

Lakeview-Scanticon Resort
Cheat Lake, Morgantown, WV

- Center Meetings are an excellent opportunity for organizations considering membership to see the Center in operation.
  - Request sponsorship by the Center or one of its current members.
  - Execution of a nondisclosure agreement.
- Watch the CITeR Website for information.

- Center meetings, activities organized with Advisory Board input to maximize benefit to Members
  - Benefits:
  - - Access to students involved in center research as future employees,
  - - Cost effect, highly leveraged research,
  - - Access to future customers,
  - - Access to interdisciplinary faculty teams spanning health sciences, the sciences, and engineering to address cross-cutting biometric system challenges,
  - - Access to a broad spectrum of interdisciplinary research labs and CAD capabilities,
  - - Advance copies of research results and publications,
  - - Proprietary position on technology transfer licensing,
  - - Semiannual advisory board meetings,
  - - Window onto important new results and technologies, and
  - - Teaming opportunities on proposals in response to government funding initiatives.

Supporting Activities at WVU

- Graduate Biometrics in Information Assurance (BIA) Program Development under support from DoD BMO.
  - Short Course and Certificate underway, MS planned
- DoD/NSA Scholarship for Service Pgm. – BIA Scholarship and Lab Development Award.
- Undergraduate Biometrics Major (BS degree) under the Forensic-ID program.

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Summary

- First National Science Foundation Industry/University Cooperative Center for biometrics
  - Initial portfolio of research projects underway
  - Integration of research and education for support of the advancement of biometrics
- An active *membership* is at the center of successful I/UCRCs.
- For additional information, visit our web site www.csee.wvu.edu/citer.

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